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Cleaner Engines for Cleaner Air: Progress and Problems in Reducing Air Pollution from Automobiles

Comptroller General of the United States

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Polluted air menaces U.S. cities, threatens the health of millions, and causes an estimated $16 billion in damage to materials and crops each year. The largest single polluter is the automobile, emitting over 90 million tons of pollutants--about 33 percent of the total--into the air in a recent year.

Because of the extent to which the automobile intensifies this pollution problem, the General Accounting Office (GAO) reviewed the progress of the Environmental Protection Agency (EPA) in combating auto-caused air pollution and the problems encountered.

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REPORT TO THE CONGRESS

Cleaner Engines For Cleaner Air: Progress And Problems In Reducing Air Pollution From Automobiles

Office of Air Programs
Environmental Protection Agency

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

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To the President of the Senate and the
Speaker of the House of Representatives

This report presents the results of our review of the Environmental Protection Agency's progress and problems in reducing air pollution from automobiles.

Our review was made pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

Copies of this report are being sent to the Director, Office of Management and Budget; the Chairman, Council on Environmental Quality; and the Administrator, Environmental Protection Agency.

Elmer B. Staats

Comptroller General
of the United States

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ABBREVIATIONS

EPA	Environmental Protection Agency
GAO	General Accounting Office
HEW	Department of Health, Education, and Welfare
OAP	Office of Air Programs
OMB	Office of Management and Budget
R&D	research and development

COMPTROLLER GENERAL'S REPORT TO THE CONGRESS

CLEAN[illegible]S FOR CLEANER AIR:
PROGR[illegible]ROBLEMS IN REDUCING
AIR P[illegible]ON FROM AUTOMOBILES
Office of Air Programs
Environmental Protection Agency
B-166506

D I G E S T

WHY THE REVIEW WAS MADE

Polluted air menaces U.S. cities, threatens the health of millions, and causes an estimated $16 billion in damage to materials and crops each year. The largest single polluter is the automobile, emitting over 90 million tons of pollutants--about 33 percent of the total--into the air in a recent year.

Because of the extent to which the automobile intensifies this pollution problem, the General Accounting Office (GAO) reviewed the progress of the Environmental Protection Agency (EPA) in combating auto-caused air pollution and the problems encountered.

EPA delegated authority for controlling auto-caused air pollution to its Office of Air Programs (OAP).

FINDINGS AND CONCLUSIONS

After a slow start OAP has made some progress in controlling auto-caused air pollution and in developing new ways of reducing it. But much remains to be done before desired control over pollutants from cars on the road is achieved. GAO has identified several problems that have retarded OAP's efforts and limited its progress.

Responsibilities for controlling mobile sources (cars, trucks, buses, etc.) of air pollution have increased rapidly and have been fragmented and dispersed throughout OAP's organizational structure which has undergone numerous changes in recent years. GAO believes that the organizational instability had a detrimental--though intangible--effect on OAP's progress. (See pp. 14 to 16.)

Controlling air pollution from cars

Emissions can be measured for compliance with established standards during three stages in the life cycle of a car--design, production, and actual use.

Progress in OAP's program has been limited to the first stage--certification of prototype cars as meeting emission standards. Weaknesses in the certification process have diluted the control thought to have been achieved over two pollutants, hydrocarbons and carbon monoxide, on the approximately

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40 million cars certified since the program began in the 1968 model year.

The certification process was not as effective as it could have been because OAP used the manufacturers' tests as the sole basis for certification. OAP permitted the manufacturers to:

--Conduct the tests of their own cars by using inadequate procedures developed largely by the auto industry.

--Average emissions from several prototypes, with the result that some models that did not meet established standards were certified.

In November 1970 OAP revised its procedures for certifying prototypes. Effective with the 1972 model year, OAP began using a revised test procedure considered more representative of normal driving conditions and more accurate for measuring carbon monoxide and hydrocarbon emissions.

The procedures eliminated the averaging concept by requiring that the emissions from each prototype tested meet established standards before the prototype is certified. (See pp. 18 to 25.)

Regulation of a third major car pollutant--nitrogen oxides--does not become effective until the 1973 model year.

In addition, effective programs are needed to measure emissions of cars (1) as they come off the production line and (2) while they are in use by the public because emissions from handbuilt, finely tuned prototypes are not representative of emissions from mass-produced cars.

For years OAP has recognized the need for assembly-line testing to ensure that mass-produced vehicles meet emission standards. Although GAO believes that the Congress authorized such testing when the Clean Air Act was amended in 1965, OAP was uncertain of its authority and for nearly 5 years OAP failed to develop an assembly-line test program.

Currently OAP is exploring means of developing an assembly-line test. Its goal was to begin nationwide assembly-line testing on 1973 model cars, but EPA officials told GAO that assembly-line testing would be delayed until at least the 1974 model year because a number of problems first must be resolved. (See pp. 26 to 29.)

The final, and perhaps most important, step in emission control is the periodic inspection of a car's emissions throughout its useful life. Tests of cars in actual use showed that their emissions often exceeded the standards applicable to the certified prototypes.

OAP has not aggressively promoted the establishment of highway inspection programs. Currently it is analyzing the estimated costs and benefits of various programs. OAP officials told GAO that the analysis would not be completed until 1973 and that it would be 2 to 4 years (1973-75) before the States implemented effective highway inspection programs.

Although various inspection programs are being considered, OAP hopes to achieve some measure of control over the emissions from cars on the road through its recall program planned for 1972 models. Manufacturers will be required to recall nonconforming cars when the EPA finds that a substantial number of a particular model although properly maintained and used, do not conform to standards.

The recall program has one inherent weakness, however--the return of cars for modification is voluntary. Manufacturers are required to notify owners of their cars' nonconformity with emission standards, but the owners are not required to take their cars in for necessary modification to the pollution control systems. (See pp. 30 to 33.)

In similar industry recall programs related to automobile safety, only 30 to 40 percent of the owners notified returned their cars for modification.

Research, development, and testing of pollution control systems for conventional automobile engine

OAP did not have the financial resources needed to undertake a comprehensive program to research and develop systems for controlling pollution from conventional automobile engines. Consequently its objective was to stimulate the automobile manufacturers not only to increase their efforts in research but also to initiate research and development work in promising new areas resulting from OAP research.

OAP did not seek sufficient information regarding the auto industry's research and development efforts for use as a basis for planning and directing its own program.

As a result its efforts often appeared to parallel, if not duplicate, those of the auto industry.

Officials of the major automobile manufacturers told GAO that OAP's research and development efforts generally had produced results already well known throughout the industry and consequently of little or no benefit.

The Clean Air Amendments of 1970 placed on the automobile manufacturers the burden of cleaning up the conventional auto engine. As a result of these amendments and of the small expenditures made by OAP for cleaning up the engine, OAP discontinued its research and development of emission control devices for the conventional auto. (See pp. 39 to 44.)

The search for an unconventional, low-polluting automobile engine

OAP's program to find an unconventional, low-polluting automobile engine, which began in 1969, has moved at a slow pace and, in GAO's opinion, down too many trails.

Commitment of resources has not been equal to the need nor has it reflected the significance of the automobile's contribution to the air pollution problem.

OAP's limited resources have been spread over many engine developments, including those with little likelihood of timely success and thus have slowed the pace of development of the most promising engines. Also OAP did not obtain needed information to ensure that its limited resources were not spent in duplicating work already performed by the automobile manufacturers.

A fiscal year 1972 budget cut by the Office of Management and Budget strongly influenced a decision by OAP to discontinue work on engine systems requiring long-term development and to concentrate its resources on the most promising engines; namely, the gas turbine, the Rankine cycle engine, and the stratified-charge engine. (See pp. 45 to 55.)

Through its Federal Clean Car Incentive Program, OAP hopes to stimulate privately funded development and limited production of low-polluting cars by 1975. The program began in 1969 but has made little progress because it offers insufficient incentive in view of the dollars a firm must spend to complete the program.

Also, because of the Government's policy of normally retaining rights to inventions resulting from work financed by the Government, OAP did not offer potential applicants the incentive of receiving any patent rights attributable to their work. GAO was informed by EPA that its Office of General Counsel was working with OAP to find a solution to the patent problem. (See pp. 56 to 58.)

RECOMMENDATIONS OR SUGGESTIONS

None.

AGENCY ACTIONS AND UNRESOLVED ISSUES

By letter dated March 3, 1972, EPA stated (see p. 61) that this report:

> "*** is generally quite fair and accurate. It documents the difficulties encountered in developing and implementing a technically complicated program and the progress that has been made since 1970."

MATTERS FOR CONSIDERATION BY THE CONGRESS

Because of a number of administrative weaknesses, the control of pollution from automobiles has not been as effective as the problem demanded. A number of policy and procedural changes have been made in the past several months that, if properly implemented, should result in a more effective

program. GAO believes, however, that the following matter requires the attention of the Congress.

The proposed recall program (see p. 32) is voluntary. Generally, in prior industry recall programs related to automobile safety, only 30 to 40 percent of the owners notified returned their cars for modifications. There is no reason to expect that a significantly greater number of owners voluntarily would return their cars for modification when notified that their cars' emissions exceeded the standards. As a result the potential effectiveness of the recall program could be lessened significantly. The Congress therefore may wish to consider the need for additional legislation to require car owners, who have been notified that their cars' emissions exceed established standards, to return them for modification.

CHAPTER 1

A LOOK AT AIR POLLUTION

THE PROBLEM AND ITS COMPLEXITIES

"Air Pollution Called Most Immediate Health Hazard."

"Cars: A Major Pollution Cause."

These are typical of headlines frequently appearing in the morning newspaper. Until recent years man paid little attention to the effects of his using the atmosphere as an aerial dumping ground. But now, since some cities are frequently under a blanket of polluted air, the Nation has become increasingly concerned about the perils of air pollution.

--In 1969 the California Senate nearly passed a resolution to ban from the State, beginning with 1975 models, cars having conventional internal combustion engines.

--In August 1970, 15 States filed a suit in the U.S. Supreme Court in an attempt to force automobile manufacturers to produce pollution-free cars at the earliest possible date.

Some scientists predict that air pollution may result in our being drowned or frozen. Those adhering to the so-called greenhouse effect theorize that pollutants are preventing the earth's heat from escaping into space, which, in a few decades, could result in the melting of the polar ice caps and the flooding of coastal regions. Others, propounding the icebox effect, say pollutants are blocking sunlight from the earth, which could lower the earth's temperature sufficiently to cause a return to the ice age!

Adding complexity to the problem are the many urban areas--having heavily concentrated car populations--which lie in natural basins, such as areas around bays, or in flat areas backed against mountains. Los Angeles, California, is one example. These basins are natural gathering

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places for low-lying masses of warm air. In the phenomenon known as an inversion, polluted air becomes trapped beneath the invisible ceiling of warm air and prevents the normal upward flow of pollutants to a level where they would be dissipated or diluted. Obviously nothing can be done to change the topography or air flows of these basins. Control must be focused on the polluters.

The effects of air pollution are widespread and costly in terms of damage to plant life, buildings, and materials. The polluted air of the Los Angeles basin has caused a serious decline in citrus and salad-type crops south of the city and has damaged trees in the San Bernardino National Forest 50 miles away. Hundreds of acres of the famous ponderosa pines in that national forest are given but 20 years to live. The Boston-to-Washington area is now exposed to agricultural losses of the same kind as those experienced in southern California.

In New York City it costs hundreds of thousands of dollars a year to keep air pollution from discoloring the buildings of Rockefeller Center. Air pollutants damage textiles, discolor dyes, and greatly accelerate the cracking of rubber.

Perhaps most frightening is the potential hazard air pollution poses to the health of millions of Americans. The diseases most commonly associated with air pollution are emphysema, bronchitis, and other respiratory ailments. Air pollution also has been linked to asthma, acute respiratory infections, allergies, and other ailments.

Although estimates of the cost of air pollution reach into billions of dollars a year, Americans may never know the true dollar cost to the Nation. What dollar value can be set for aesthetic, psychological, and health losses? What is the dollar value of a human life?

Some estimates of the more tangible costs have been made, however. Air pollution has been blamed for more crop damage than has the weather. The first annual report of the Council on Environmental Quality estimated damage to agricultural crops and livestock at $500 million a year. EPA estimates that the total cost of air pollution damage exceeds $16 billion a year.

About 280 million tons of pollutants were pumped into the air in 1969. About one half came from the smokestacks of factories and power-generating plants, from disposal of solid waste, and from miscellaneous stationary sources, such as forest fires and agricultural burning. The remaining pollutants came from mobile sources--primarily cars and trucks powered by conventional internal combustion engines.

In 1969, as shown in the graph on page 10, motor vehicles were the source of nearly two thirds of the carbon monoxide, nearly half of the hydrocarbons, and about one third of the nitrogen oxides emitted into the atmosphere. Motor vehicles were the source of a much smaller proportion of the particulate and sulfur oxide emissions--less than 1 percent in both cases.

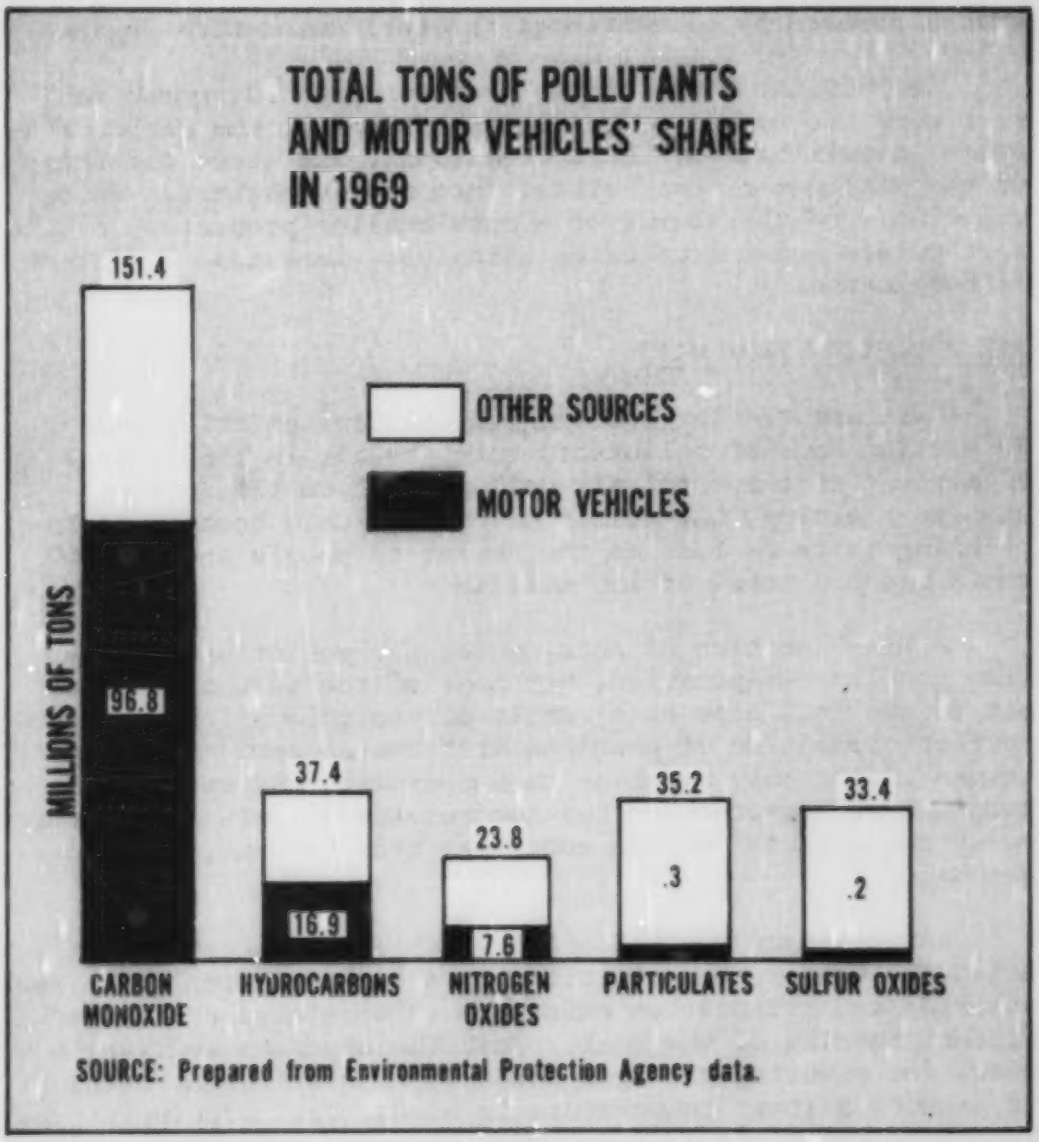
AIR POLLUTION FROM CARS

Cars are the largest single polluter, emitting over 90 million tons of pollutants into the air in 1969--about 33 percent of the total air pollutants from all sources! Just as alarming, the number of cars in this country is increasing twice as fast as the number of people and by 1980 could reach a total of 150 million.

A small portion of auto-caused air pollution results from gasoline evaporation, but most of the pollution comes out of the tail pipe as a result of the combustion process. Perfect combustion of gasoline with the correct amount of oxygen yields only harmless carbon dioxide and water. Incomplete or imperfect combustion results in emission of three major pollutants: carbon monoxide, hydrocarbons, and nitrogen oxides.

Simultaneous control of these three pollutants poses a dilemma. One of the conditions favoring reduction of carbon monoxide and hydrocarbon emissions is more complete and efficient burning of the fuel. Just the opposite is true, however, for reducing nitrogen oxides: Less efficient burning to produce a lower temperature is needed for reducing nitrogen oxide emissions.

The auto industry estimates that new car devices needed to reduce emissions to meet the Federal requirements


TOTAL TONS OF POLLUTANTS
AND MOTOR VEHICLES' SHARE
IN 1969
MILLIONS OF TONS
OTHER SOURCES
MOTOR VEHICLES
151.4
96.8
37.4
16.9
23.8
7.6
35.2
.3
33.4
.2
CARBON MONOXIDE
HYDROCARBONS
NITROGEN OXIDES
PARTICULATES
SULFUR OXIDES
SOURCE: Prepared from Environmental Protection Agency data.

discussed on page 13 may cost as much as $600 for each car in 1975.

Effects of auto pollutants on health

Although knowledge of the health effects of specific auto pollutants is far from complete, some effects have been defined.

--Carbon monoxide is a colorless, odorless, tasteless gas that, when inhaled, hinders the blood from carrying oxygen to the body tissues. This, in turn, diminishes reflexes, visual sharpness, and muscle coordination; causes headaches; impairs judgment; damages arteries and heart tissues; and may hinder development of the unborn child. Having the same effect on a heart patient as strenuous exercise, carbon monoxide has been associated with fatal heart seizures.

--Hydrocarbons, produced from incomplete burning of gasoline, are a complex mixture of different compounds. Although it is thought that some hydrocarbons may have carcinogenic (i.e., cancer-causing) effects, evidence is inconclusive. Of primary concern, however, is their indirect effect through interaction with nitrogen oxides under sunlight to form photochemical smog which causes irritation to eyes and damage to vegetable life.

--Nitrogen oxides are major participants in photochemical smog reactions and, when breathed deeply, can cause bronchial and pulmonary damage.

Although the auto's share of particulate pollution is relatively small, a significant portion of its contribution is made up of lead that is added to gasoline. Lead particles can be eliminated by the use of lead-free gasoline which could be used in many 1971 cars. The emission control systems being contemplated by the auto manufacturers for 1975 cars may be such as to require the use of lead-free gasoline.

Oxidants, another pollutant category commonly known as smog, result mainly from the photochemical reaction of

hydrocarbons and nitrogen oxides. Oxidants cause eye irritation and, in large quantities, have been known to impair the athletic performance of school children and to hinder breathing of those afflicted with lung conditions, such as emphysema.

FEDERAL PROGRAM TO CONTROL AUTO-CAUSED AIR POLLUTION

The Federal program to control auto-caused air pollution has evolved over several years. In 1955 the Federal Air Pollution Research and Technical Assistance Act (42 U.S.C. 1857) authorized a modest Federal air pollution program: State and local governments were to assume basic responsibility for prevention and control. In 1965 the Secretary of Health, Education, and Welfare was given the specific responsibility for controlling auto-caused pollution by amendments to the Clean Air Act of 1963. The Secretary was authorized to:

--Set and enforce emission standards (a limit on the amount of pollutant a vehicle can emit) for new motor vehicles and to prohibit the sale of those vehicles exceeding the standards.

--Conduct research on ways to control auto emissions.

In 1967 further amendments to the act gave the Secretary of Health, Education, and Welfare authority to register fuel additives, to expand research and development programs on automotive emissions control technology, and to make grants to assist the States in developing suitable highway inspection programs.

In December 1970, however, the most significant legislation was enacted. In Public Law 91-604, amending the Clean Air Act, the Congress greatly expanded the authority and responsibility of EPA.[1] This reflected a tough stance in

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[1]EPA was established on December 2, 1970, in accordance with Reorganization Plan No. 3 of 1970. Prior to that date the air pollution control program was administered by the Department of Health, Education, and Welfare (HEW).

the Government's fight against air pollution, particularly that caused by autos. The amendments called for

--90-percent reductions by 1975 in the hydrocarbon and carbon monoxide emissions allowable on 1970 cars,

--90-percent reduction by 1976 in the nitrogen oxide emissions measured on 1971 cars,

--testing of production vehicles at the assembly line for conformity to standards,

--50,000-mile manufacturer warrantees on emission control devices,

--testing and recalling vehicles in public use if a substantial number fail to meet standards, and

--regulating sale of fuels and fuel additives that endanger public health or welfare or that impair the operation of emission control devices.

EPA's efforts to develop and implement programs to ensure compliance with these requirements are under way.

The air pollution control program in EPA is administered by OAP. OAP activities are directed by its headquarters staff located in Rockville, Maryland. Motor-vehicle-related activities, as of September 1971, were carried out by a staff of 112 people in research and testing facilities located in Ann Arbor, Michigan. For fiscal year 1972 the budget for Clean Air Act programs is $143 million; $18.6 million, or 13 percent, has been allocated primarily to auto programs.

CHAPTER 2

ORGANIZATIONAL INSTABILITY

CAP's organizational structure has undergone numerous changes over the years, especially since 1967. Although the scope of our review did not include intensive study of the frequent reorganizations, we believe that they had a detrimental--though somewhat intangible--effect on OAP's progress and contributed to some of the weaknesses described in the following chapters. The organizational instability is discussed here to put OAP's past efforts in proper perspective.

As its responsibilities for controlling motor vehicle emissions increased, beginning with the 1965 amendments to the Clean Air Act, OAP, as an organization, began to grow.

--The motor vehicle compliance section was established in October 1965 as part of the Division of Air Pollution, the forerunner of the current OAP, which had been created in HEW in September 1960.

--In 1966 the motor vehicle compliance section was relocated from Cincinnati, Ohio, to Ypsilanti, Michigan. The official responsible for these activities told us that he had lost all his experienced automotive staff members in the move--some had been reassigned and some had refused to move.

--In 1967 the Division of Air Pollution became the National Center for Air Pollution Control.

--In 1968 the Center became the National Air Pollution Control Administration. At that time the center had a staff of about 1,000, more than double what it had just 4 years earlier. With this change the motor vehicle compliance section was reorganized to assume expanded responsibilities.

--In 1969 the motor vehicle research and development program was relocated from Cincinnati to Ann Arbor.

Motor vehicle control responsibilities were fragmented and were dispersed throughout the organizational structure. An internal study of the National Air Pollution Control Administration motor vehicle program made during the spring of 1970 culminated in the recommendation that all motor-vehicle-related responsibilities be consolidated at the operating level. In July 1970 the Mobile Source Pollution Control Program was formed to consolidate these responsibilities. Formal reorganization of the motor vehicle organizational units into a bureau of mobile source pollution control was not approved by HEW at that time because of the impending creation of EPA.

In December 1970 the National Air Pollution Control Administration was moved from HEW to the newly created EPA and became known as the Air Pollution Control Office.

In February 1971 the Mobile Source Pollution Control Program was reorganized on an interim basis. In April 1971, EPA reorganized and the Air Pollution Control Office became known as the OAP.

Consolidation of motor vehicle responsibilities in July 1970 grew out of the findings of OAP's internal study revealing that (1) these responsibilities were dispersed throughout the organization and (2) since OAP was oriented toward stationary-source control, motor vehicle programs did not fit well into the patterns designed to deal with stationary sources of pollution. Related findings included in the study report were:

> "There is no clear-cut, coordinated strategy, nor subordinate long- and short-term program plans, designed to achieve specific goals. To varying degrees, each organizational element has its own plans--in some cases, almost no plans are apparent. Integration of related plans and activities is inadequate. Part of [the] reason for lack of planning appears to be in diffusion of MS [mobile source] functions. By making MSPC [mobile source pollution control] in part everyone's job, it tends to become no one's job. ***"

* * * * *

"Plans for collection of surveillance data are not coordinated with data users. *** State vehicle inspection programs [are] not planned; responsibility for this program *** has bounced around awkwardly."

* * * * *

"NAPCA [now OAP] as an organization is ill-equipped to be responsive to external demands and inquiries. *** There is some evidence of major policy issues being dealt with at Branch [lower] levels without reference to headquarters. *** Outsiders don't know where in NAPCA to take up issues."

Our discussions with OAP officials and auto and oil company representatives confirmed these findings. OAP officials at the operating level told us that projects sometimes were dropped or delayed because of conflicting priorities at different levels of management, pressure exerted by public opinion and other sources outside OAP caused priorities to fluctuate, and plans formulated at the operating level received little input from higher levels of management.

Auto and oil company representatives told us that OAP's frequent reorganizations made it difficult to contact appropriate persons and to get needed information and that OAP lacked a stable organization and an effective chain of command. These representatives told us that, before the motor vehicle responsibilities were consolidated organizationally, it often was necessary to contact five or six persons to get needed answers and decisions.

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We believe that OAP's efforts to control air pollution from motor vehicles should be viewed in the light of the organizational instability under which OAP has labored. Although the effects are somewhat intangible, we believe that the numerous organizational changes have contributed to the management and administrative problems discussed in the following chapters.

CHAPTER 3

CONTROLLING AIR POLLUTION FROM CARS

The Congress, in the 1965 amendments to the Clean Air Act, called for a Federal program to reduce air pollution from cars by prohibiting the sale of new cars--domestic and foreign--that do not conform to Federal emission standards. Further amendments in 1967 provided for Federal assistance to States to develop programs for on-the-road inspections to ensure that cars would continue to meet the standards.

A car can be tested and its emissions measured for compliance with established standards during three stages in its life cycle: the design stage, the production stage, and the actual-use stage. The design stage involves prototype cars prior to mass production; the production stage involves mass-produced cars as they come off the assembly line; and the actual-use stage involves cars in the hands of the public.

As of September 1971 progress in OAP's program had been limited to the first stage[1], testing emissions from prototype cars for two of the three most significant car pollutants--carbon monoxide and hydrocarbons, which first were regulated on the 1968 model cars. Nitrogen oxide emissions are to be regulated beginning with the 1973 model cars. OAP hoped to have an assembly-line testing program for mass-produced cars beginning with the 1973 models, but EPA officials told us that such testing would be delayed until at least the 1974 model year. OAP has awarded three grants to State and local governments to develop highway inspection programs.

After spending 4 years and several million dollars enforcing standards at the prototype stage, OAP has achieved some reductions in the emission levels of prototypes. OAP's program for controlling emissions from prototypes was not

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[1]This stage involves a certification process wherein prototype cars are tested for conformity with prescribed regulations and, upon being approved, are issued a certificate of conformity by OAP.

as effective as it could have been, however, because OAP used the manufacturers' tests as the sole basis for certification and permitted the auto manufacturers to (1) conduct the tests of their own cars using inadequate procedures largely developed by the auto industry and (2) average emissions from several prototypes, with the result that some cars that did not meet established standards were certified. OAP's early efforts--hampered by limited funds and manpower and by rapidly increasing motor vehicle responsibilities--sometimes were characterized by compromise with the automobile manufacturers and rubber-stamping of certificates.

In November 1970, however, OAP revised its procedures for certifying prototypes. Effective with the 1972 model year, OAP began using a revised test procedure which it considered more representative of normal driving conditions and more accurate for measuring carbon monoxide and hydrocarbon emissions. In addition, the procedures eliminated the averaging concept by requiring that the emissions from each prototype tested meet established standards before the prototype was certified. OAP began using also some of its own, rather than the manufacturers', test results as a basis for certifications.

But much remains to be done. Regulation of the third major car pollutant--nitrogen oxides--does not become effective until the 1973 model year, primarily because of technical problems in developing adequate instrumentation to measure this pollutant. In addition, programs of assembly-line testing and highway inspections are needed.

CERTIFICATION OF PROTOTYPES--STEP ONE

Section 206(a) of the 1965 amendments to the Clean Air Act states that:

> "Upon application of the manufacturer, the Secretary [Administrator, EPA] shall test, or require to be tested, in such manner as he deems appropriate, any new motor vehicle or new motor vehicle engine submitted by such manufacturer to determine whether such vehicle or engine conforms with the regulations prescribed ***. If such vehicle or engine conforms to such regulations the

Secretary shall issue a certificate of conformity, upon such terms, and for such period not less than one year, as he may prescribe."

OAP's certifications of cars as meeting emission standards for carbon monoxide and hydrocarbons were based on tests of limited numbers of prototype cars selected by OAP to represent a major portion of manufacturers' sales volumes. An estimated 10.6 million cars produced by the four major domestic automobile manufacturers in 1971 were certified on the basis of tests of 242 prototypes. A 1971 prototype, for example, is a 1970 model equipped with all the components and modifications affecting emissions that are planned for 1971 models. Weaknesses in OAP's procedures for testing and measuring emissions from prototypes diluted the effectiveness of OAP's certification of prototypes prior to model year 1972.

Selection of prototypes and control over test data

OAP did not require that each engine-component combination be tested. Instead, each engine size (determined by cubic-inch displacement) was tested by the manufacturer in four prototypes equipped with various combinations of transmissions, carburetors, and other components. (Only two prototypes were tested for engine sizes having less than 50,000-unit sales.) Because a manufacturer often put the same size engine in more than four different component combinations, not all possible component combinations were tested. OAP officials told us that the engines to be tested had been selected on the basis of engineering judgment.

Engine-component combinations for cars that are designed for speed and power--commonly known as "muscle cars"--are known to be unusually high polluters. These cars seldom were tested as prototypes because of their relatively low sales volume, but they always were certified as a result of the sales-percentage adjustments discussed on page 20.

After the prototypes were selected, the manufacturers conducted emission tests and submitted the test results to OAP. In accordance with OAP procedures (1) the manufacturers could test and retest the prototypes any number of

times, (2) the manufacturers could average the emissions for prototypes tested in each engine size, and (3) the manufacturers' test data was used as the sole basis for certifications.

These procedures, in our opinion, did not provide OAP with a sufficiently reliable basis for certifying prototypes as being in compliance with emission standards.

OAP officials acknowledged that the procedures did not preclude the manufacturers from tuning and retesting the prototypes until tests indicated that the emissions were in compliance with the standards. Furthermore the manufacturers were not required to inform OAP as to the number of tests performed and were not precluded from submitting only the most favorable test results for each prototype.

The four prototypes that OAP selected for test and certification for each engine size were driven by the manufacturer 4,000 miles, were tested, and the emission levels were recorded as shown in column A of the table on page 21. To account for deterioration in emission levels as a car ages and as miles accumulate, each emission control system was tested to 50,000 miles on prototypes selected to represent at least the top 70 percent of the manufacturer's projected sales volume. Results of the 50,000-mile tests were used in computing deterioration factors which were applied to the emissions from the prototypes tested after 4,000 miles. (See col. B of the table.)

In the final step of the computation, each of the four prototype emission values was weighted in proportion to the percent of the engine's sales represented by each of the four component combinations. (See col. C.) Because some engine-component combinations were not tested, however, the sales-weighting percentages often had to be adjusted judgmentally to represent 100 percent of all component combinations with that size engine. The adjustments were made by adding the sales percentage for the engine-component combinations not tested to the sales percentage of the prototypes whose components were most nearly the same.

The weighted emission levels for each of the four prototypes were totaled (see col. D) and the results compared

with the emission standard to determine compliance. For example, the standard for hydrocarbons for 1971 models was 2.2 grams per vehicle-mile.

OAP Computation of Hydrocarbon Grams per Mile for 360-Cubic-Inch-Displacement Engine in Prototypes

	4000-mile emission test (note a) (A)	Deterioration factor (note b) (B)	Percent of engine sales (C)	Sales-weighted emission levels (AxBxC) (D)
Car 1	2.19	1	31.9	0.70
2	2.28	1	31.9	.73
3	2.18	1	18.1	.39
4	1.75	1	18.1	.32
			100.0	2.14

[a]The emission values for all cars tested by the manufacturer were lower than OAP's test results.

[b]In the manufacturer's tests a deterioration factor of 0.96 was used. This factor indicates that emissions decrease with age and mileage. Since emissions are known to increase with age and mileage accumulation, however, OAP assumed a deterioration factor of 1, which indicates no change. OAP disallowed the submission of deterioration factors of less than 1 in 1972.

OAP's test data in the above table illustrates that, even though the emissions from one of the four prototypes failed to meet the standards, the car still could be certified if the average emissions of the four cars tested were within the standard. Although the actual emissions (2.28) from car 2 exceeded the standard (2.2), all four cars could have been certified because the average emissions (2.14) were within the standard.

OAP officials told us that, theoretically, averaging the emission levels of several cars could result in all cars with a given engine size being certified, even if the emissions from half of the cars exceeded the standards.

As stated on page 19, the auto manufacturers conducted the emission tests and submitted the test results to OAP for certifying the prototypes. OAP officials told us that the number of persons available to certify cars was limited and generally fluctuated between three and five persons. Because of the limited staff, OAP did little monitoring of the manufacturers' tests. One OAP official labeled the monitoring efforts "a lesson in futility."

Although OAP tried to confirm some of the manufacturers' test results by testing prototypes in its own laboratory, it did not use these confirmatory tests as a basis for either approving or denying certification. Even if prototypes passed manufacturers' tests but failed OAP's, the manufacturers' test results were considered official and were used as the basis for certifications.

Effective with model year 1972 OAP revised its procedures to correct the above weaknesses. The selection of prototypes is to be based on more reasonable groupings of engine families--those expected to have similar emission characteristics, considering the transmissions, fuel systems, vehicle weights, engine sizes, and control systems. Additional prototypes from each engine family can be tested if they are suspected of having high emissions or if they were missed in prior selections. An OAP official told us that, as a result of these revised procedures, some 1972 muscle cars had been dropped from the product line of some manufacturers.

Under the revised procedures manufacturers will be able to have a prototype retested only once. If the prototype fails to meet the standard when retested, the manufacturer must substitute another prototype or modify the engine. Also on 1972 models OAP began using its own test results as a basis for certification and began requiring that all prototypes tested for each engine family meet the emission standards. If any prototype fails these tests, the engine family will not be certified.

Test procedures did not provide for accurate measurement of emission levels

The level of emission control achieved on prototypes normally is expressed in terms of the percentage of reduction in emissions from the prototype in relation to the emissions from an uncontrolled car. Because the emission test and measurement procedures used prior to model year 1972 did not reflect the total quantity of pollutants being emitted, the percentage reductions achieved were less than those originally estimated by OAP.

The test procedure and standards applied to model 1968 and 1969 cars were adopted, without substantial change, from an existing air pollution control program in the State of California, because time and technical limitations did not permit OAP to develop a better program prior to certification of model year 1968 cars. Because of the lead time required for the certification process, OAP was required to publish its program in March 1966--just 5 months after enactment of the 1965 amendments authorizing certification. According to OAP officials the auto industry had played a significant role in devising the procedure under which cars were tested. Under the seven-mode, seven-cycle test, the prototypes were put through a set pattern of driving conditions or modes (supposedly representative of urban driving) seven times. (See app. III.) Emissions were measured only during seven selected periods and were measured in terms of pollutant concentrations during the sample periods with little regard to the total volume of pollutants emitted during the entire test.

Because the auto industry had a significant role in devising the test procedure, the automobile manufacturers were quite proficient, according to OAP officials, at passing the test by tuning the prototypes and designing the control systems to perform well and thus emit the fewest pollutants during the sample periods.

OAP made some changes in the measurement technique used on 1970 and 1971 models but continued to measure emissions only during the seven sample periods. A substantial improvement was made in the test procedure, however, beginning with the 1972 model year, when the tests were conducted

over a more representative driving cycle and on a true mass-measurement basis--sampling the exhaust volume continuously rather than only during selected periods. OAP officials told us that some manufacturers dropped certain car models from their 1972 product lines because they concluded that the models could not pass the new test.

The standards applicable to 1970 and 1971 model cars for hydrocarbons and carbon monoxide were 2.2 grams and 23 grams, respectively, per vehicle-mile--one mile traveled by one vehicle. (About 453 grams equal 1 pound.) Thus if a car met the standards, it would pump 1 pound of hydrocarbons into the air every 206 miles and 1 pound of carbon monoxide every 20 miles. As shown in the following table, the standards represented a reduction in the two pollutants of 80 percent and 69 percent, respectively, from the noncontrolled levels of a pre-1968 car. Because of the inadequate testing procedures, however, these intended reductions were not achieved on prototypes until the 1972 model year. The 1970 and 1971 cars, both tested under the new procedure subsequently used for 1972 models, showed a 73-percent reduction in hydrocarbons and a 62-percent reduction in carbon monoxide.

	Hydrocarbons (grams per vehicle-mile)		Carbon monoxide (grams per vehicle-mile)	
	Old test	New test	Old test	New test
Emissions of noncontrolled car	11.2	17	73	125
Standard for 1970-71 models	2.2		23	
Intended degree of control	80%		69%	
Emissions from 1970-71 models using 1972 procedures		4.6		47
Achieved degree of control		73%		62%
Standard for 1972		3.4		39
Intended degree of control		80%		69%

Although they were somewhat less than intended, the 73-percent and 62-percent reductions were significant

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On the basis of the annual production of approximately 10 million cars, about 40 million cars were added to the highways between model years 1968, (when OAP began certifying prototypes) and 1972. Never in this period did OAP prohibit sale of a manufacturer's cars for failing to meet emission standards.

OAP officials stated that this might have been due, in part, to manufacturers' dropping cars from their product lines when expected sales did not justify the expenditures required to reduce the cars' emissions to meet established standards. Although they knew of no such cases for domestic manufacturers, the officials said that importation of two foreign models had been discontinued because of the expenditures required to reduce emissions to established standards.

We believe that, to some extent, the fact that prototypes always were certified can be attributed to the weaknesses in the pre-1972 certification procedures--weaknesses so significant as virtually to ensure certification of all prototypes tested. OAP recognized these weaknesses and made a number of changes in the revised procedures for the 1972 model year, and, as a result, the certification program should be more effective in the future.

ASSEMBLY-LINE TESTING--STEP TWO

OAP officials have told us that, because prototypes are hand built and finely tuned by the manufacturers, their emissions are not typical of those from mass-produced cars. Thus even with an effective program for certifying prototypes, OAP needs assurance that emissions from mass-produced cars will meet Federal standards when the cars are sold. Assembly-line testing would provide that assurance.

A consulting firm, hired by OAP to study the assembly-line test problem, reported in August 1970 that:

> "*** the certificate test results on a prototype should be considered as representative of the best emission performance which may be expected of that engine class.
>
> "*** there may be a very real difference between a design concept (as represented by a prototype) and a mass-produced engine. In general, the parts for the prototype are produced under more stringent control than are the parts for the mass-produced engine, they are assembled with more care, and the prototypes may receive a degree of tuning rarely achieved in production engines. The operations involved in building mass produced engines have a degree of variability (over those used with prototypes) which should act to increase emissions. Just because a prototype has been certified, is no reason to expect that all individual engines, as produced, will behave as does the prototype ***."

For years OAP has recognized the need for assembly-line testing to ensure that mass-produced vehicles meet emission standards. Although we believe that the Congress authorized such testing when the Clean Air Act was amended in 1965, OAP was uncertain of its authority, and for nearly 5 years it failed to develop an assembly-line test program.

The act, as amended in 1965, provides that:

> "Upon application of the manufacturer, the Secretary [Administrator, EPA] shall test, or require to be tested, in such manner as he deems appropriate, any new motor vehicle or new motor vehicle engine submitted by such manufacturer to determine whether such vehicle or engine conforms with the regulations prescribed ***."

In 1967 OAP requested a legal opinion regarding its authority to revoke certifications of prototypes. In March 1967 HEW's chief legal adviser to the Federal air pollution program expressed the opinion that OAP had the authority to initiate an assembly-line testing program to verify certifications and to revoke certifications on those models whose emissions failed to meet prescribed standards.

OAP decided, however, to await legislative clarification by the Congress because of

--the fear of being contested in court by the automobile manufacturers and

--the substantial impact on the automobile manufacturers if noncomplying cars could not be brought into conformity with the standards.

The Secretary of HEW requested the Congress to provide him with the specific authority to test production vehicles at the assembly line for conformity to standards. The Senate Committee on Public Works expressed the view that the Secretary had that authority under the 1965 amendments to the act, but, nevertheless, in section 206 of the Clean Air Amendments of 1970, the Congress authorized EPA to develop needed methods and procedures for an assembly-line test program to be conducted by the agency or by the manufacturer. OAP currently is exploring means of developing an assembly-line test.

In the absence of a Federal program, the State of California obtained a waiver[1] from EPA and devised its own assembly-line test for 1972 model cars sold in the State. The auto manufacturers are required to test, as they come off the assembly line, 25 percent of the cars produced for sale in California. They are to use a shortened version of the now-obsolete seven-mode, seven-cycle test. About 2 minutes are required to test each car.

California obtained a second waiver from EPA to expand the program to require assembly-line testing of all cars sold in California after January 30, 1973. The EPA Administrator told the State that the waiver had been approved only because he did not have a sufficient basis under the Clean Air Act to deny the request, notwithstanding the fact that (1) he seriously questioned the value of California's short assembly-line test in reducing air pollution and (2) the additional testing required in 1973 would add substantially to the cost of cars sold in California.

The Administrator's reservations concerning California's test procedures appear to have been borne out. In a report issued in October 1971, the Technical Advisory Committee of the State of California's Air Resource Board stated that:

> "There is serious doubt that the results obtained by the 7-mode hot start procedure justify using this for 100% testing instead of a simpler, and hence less expensive to the consumer procedure. *** It [the 7-mode] is superior to an idle test for nitrogen oxides but it does not appear to be superior to an idle test for hydrocarbons and carbon monoxide. It would cost the consumer more--about $50 versus $10 or $15--and it would

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[1]The Clean Air Act authorizes the Administrator to waive provisions of the act relating to the control of pollution from autos if a State adopted standards prior to March 31, 1966, and the State standards were more stringent than Federal standards. The State of California is the only State that qualifies for a waiver.

require the construction of new physical facilities by the automobile manufacturers. These physical facilities would be obsolete if the federal government adopted a different assembly line test procedure, and the time required to build these facilities would probably prevent the manufacturers from starting 100% testing on 30 January 1973. Furthermore, it is doubtful that the 7-mode hot start test gives us sufficient additional control to justify the added expense to the consumer, compared to a simple idle test."

OAP's goal was to begin nationwide assembly-line testing on 1973 model cars. EPA officials told us, however, that assembly-line testing would be delayed until at least the 1974 model year because a number of problems first must be resolved.

OAP requested the automobile manufacturers voluntarily to test some 1972 cars as they came off the assembly line and to submit the test results to OAP. An OAP official told us that the manufacturers seemed willing to cooperate. Also, for certification of 1972 models, manufacturers are required to submit emission levels of prototypes before they accumulate 10 miles. Correlation of this near-zero-mileage emission data from prototype and production cars should be helpful to OAP in planning the assembly-line test program.

We believe that, had OAP made a greater effort to develop an assembly-line test program several years ago, when its legal adviser determined that the agency had the legal authority for such a program, many of the problems discussed above might have been resolved and that an effective, workable program could have been ready for implementation.

HIGHWAY INSPECTION PROGRAMS--STEP THREE

The final, and perhaps the most important, step in emission control is the periodic inspection of a car's emissions throughout its useful life. Prototype certifications and assembly-line testing, even if effective, would not provide assurance that cars on the road continued to meet emission standards. Tests of cars in actual use showed that their emissions often exceeded the standards applicable to the certified prototypes. For example:

--In one OAP study 2,376 tests were conducted of 1968 and 1969 cars which had been driven 20,000 to 40,000 miles in customer use. The average emissions of hydrocarbons and carbon monoxide were about 30 percent higher than the certification standards applicable to 1968 and 1969 prototypes.

--Another OAP study was made of 1970 cars that had been driven about 9,500 miles in customer use. Results of about 1,900 tests indicated that hydrocarbon and carbon monoxide emissions were about 50 percent higher than certification standards for 1970 prototypes.

Tests of OAP's in-house fleet of cars indicated also that emissions from cars in use exceeded emissions from prototypes. Tests of 92 cars driven between 15,000 and 20,000 miles showed that the emissions from these cars exceeded Federal standards more often than did their prototype counterparts with comparable mileage.

Testifying before the Subcommittee on Public Health and Welfare, House Committee on Interstate and Foreign Commerce, the OAP Commissioner acknowledged that certified cars that are in the hands of the public often may fail to meet emission standards and he cited one model whose emissions were 15 to 25 percent above allowable levels 75 percent of the time. These results were from cars having relatively low mileage, and emissions are known to increase as mileage accumulates, particularly in those cars not being maintained in accordance with manufacturer's specifications.

Thus periodic inspection of cars on the road is needed to ensure that emissions continue to meet prescribed standards.

OAP's efforts to develop highway inspection programs

The 1967 amendments to the Clean Air Act authorized Federal assistance to States for developing highway inspection programs to maintain control over emissions from cars on the road. Because of a lack of technology and data indicating that such programs would be effective in reducing automobile emissions, however, OAP has not agressively promoted the establishment of highway inspection programs.

Rather, OAP discussed the limitations of current knowledge about inspection programs with State officials and recommended against adopting programs which might prove to be of little value and which subsequently might arouse strong public opposition. (OAP estimates that a nationwide highway inspection program would cost in excess of $1 billion a year.) OAP did not want any particular inspection program adopted until an analysis could be made of the costs and benefits of various options.

OAP officials told us that, although such an analysis is currently under way, it would not be completed until 1973. OAP expects to have interim information available on various alternatives early in 1972. In May 1971 OAP estimated that 2 to 4 years would be required for the States to implement effective inspection programs.

In March 1972 EPA officials told us that:

"*** OAP has been and is hard at work to overcome certain technological obstacles that stand in the way of effective programs of this type. The lack of action by EPA to implement such programs has not resulted from an unwillingness to do so, but rather an unwillingness to foster and promote the installation of programs for which there is no basis of judging effectiveness."

OAP has given some financial assistance to a few State and local governments to develop highway inspection programs. New Jersey received a grant for $810,000. Grants have also been awarded to Washington, D.C., and to the State of California.

New Jersey recently announced plans to measure emissions in 1972 from all cars registered in the State. A car's hydrocarbon and carbon monoxide emissions are to be measured during a short test made while the engine is idling. If emissions exceed prescribed limits, the owner will be required to make whatever modifications are needed to bring the emissions within the established standards or he will be prohibited from driving the car.

New Jersey has requested additional financial assistance from OAP to implement this program, but, as of November 1, 1971, OAP officials had not made a decision on the request because they were concerned about the program's cost effectiveness.

Although various programs are being considered, OAP hopes to achieve some measure of control over the emissions from cars on the road through its recall program planned for 1972 models. The Clean Air Amendments of 1970 gave EPA authority to require the remedy, at the manufacturers' expense, of any defects in the emission control systems of cars returned by the owners. The manufacturers will be required to recall nonconforming cars when EPA finds that a substantial number (not yet determined by EPA) of a particular model, although properly maintained and used, do not conform to standards.

As of September 1971 plans for the recall program were not complete. OAP officials estimated, however, that, when the program was implemented, they would have to test about 2,000 cars annually. They said that the cars would be selected under a statistical-sampling program.

The recall program has one inherent weakness--the return of cars for modification is voluntary. Under provisions of the 1970 amendments, the manufacturer is required to notify the owner of the car's nonconformity with emission standards, but the owner is not required to take the car in

for modifications. Generally in similar industry recall programs for safety hazards, when a person's life could be jeopardized, only 30 to 40 percent of the owners notified took their cars in for modifications. Because a malfunctioning emission control system is not likely to seriously impair vehicle performance, or to even be detectable in normal driving, there is no reason to expect that a significantly greater number of owners would take their cars in for repairs.

OAP SURVEILLANCE PROGRAM

OAP began its own in-house automobile emissions surveillance program in 1966. Because of a lack of direction from top management and because of inadequate integration of the surveillance efforts into overall OAP program goals, however, the surveillance program has not been as effective as it should have been.

OAP officials told us that the goals of the surveillance program were not specifically defined. The surveillance program was divided into contract and in-house efforts. Surveillance personnel were left to define their own goals and to implement their own programs. One official told us that the entire surveillance program was initiated with little sound justification in terms of program purpose and direction of effort and that it continued much the same way until June 1971.

During the period 1966 through June 1971, the program was directed primarily to testing cars supplied by the manufacturers--an average fleet of 80 to 100 cars--to obtain data on the effects of mileage accumulation on emissions resulting from normal customer use. Between 1966 and 1968 most of the cars in the surveillance program were prototypes, and, consequently, much of the data obtained was not representative of what could be expected from mass-produced cars. In 1969 OAP began using only production-line cars.

OAP employees drove the surveillance program cars as if they owned them--to and from work and for business and personal use--to accumulate mileage on a normal customer-use basis. Maintenance costs were paid by the manufacturer; OAP paid for all gas and oil. The cars were tested by OAP at regular intervals under the now-obsolete seven-mode, seven-cycle test procedure. Little use, however, was made of the test data. A report on the testing performed from January 1967 through March 1970 was drafted in June 1970 but never published, nor were the test results disseminated.

In 1968 retention of the fleet was evaluated by OAP. OAP justified retention because of the vehicles' usefulness in providing data of significance to the surveillance program and in developing emission control test procedures.

OAP officials told us that in July 1970 they decided to re-evaluate the usefulness of the surveillance program. The decision was made to let no further surveillance contracts until a rational basis for the surveillance program had been developed. The officials stated that it took several months to do the work necessary to define a rational surveillance program.

In 1971, however, OAP concluded that, for surveillance purposes, the results obtained had been marginal at best but that the fleet had been of some benefit in the development of emission control test procedures. Also OAP concluded that the cost of operating the fleet--estimated to have been as much as $839,000 from 1966--had far exceeded the benefits to the Government. As a result OAP decided to discontinue the fleet in June 1971.

In June 1971 OAP redirected its surveillance activities and established two primary goals

--to obtain information needed by other OAP organizational units on exhaust and evaporation emissions from model year 1958 to 1971 cars and

--to test emissions from cars on the road in conjunction with the recall program discussed on pages 32 and 33.

OAP personnel, not involved with OAP's surveillance program, told us that prior to June 1971 they obtained emission data from the State of California because they were not aware of the surveillance program. OAP surveillance personnel told us that they were not aware that other organizational units in OAP had a need for the information they were compiling. When the surveillance program was redirected in June 1971, a major effort was made to identify all OAP personnel having a need for information on emissions.

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The surveillance program suffered for several years from a lack of direction and of specific, well-defined objectives. In addition, no attempt was made to correlate the information obtained under the surveillance program with

the needs of other OAP programs, and the program generally was not effective. In June 1971, however, program objectives were established and efforts were initiated to ascertain the information needs of other OAP organizational units. In our opinion these changes should improve the effectiveness of the surveillance program.

CONCLUSIONS

Progress to date in controlling air pollution from automobiles has been limited. OAP's program provides for testing emissions during three stages of a car's life cycle--design, production, and actual use. In the design stage OAP has been testing and certifying prototypes since the 1968 model year, but there have been a number of weaknesses in the certification program. Effective with the 1972 model year, a number of changes were made which should result in a more effective certification program.

Certifying prototypes, however, is only the first step toward ensuring that emissions from cars comply with established standards. Since prototypes are hand built and finely tuned by the manufacturers, their emissions are not typical of those from mass-produced cars. Thus OAP needs assurance that emissions from mass-produced cars will fall within Federal standards when the cars are sold and are in use.

Although we believe that OAP has had authority for several years to test emissions from cars as they come off the assembly line, it has not developed an assembly-line test program. OAP's goal was to begin assembly-line testing on 1973 model cars, but the testing will be delayed until at least the 1974 model year because a number of problems must first be resolved--problems that, in our opinion, might now be resolved had OAP initiated efforts several years ago to develop an assembly-line testing program.

With regard to the third stage--actual use--even less progress has been made. OAP has awarded a few grants to State and local governments to develop highway inspection programs, but it has estimated that implementation of an effective nationwide highway inspection program is 2 to 4 years away. Although various programs are being considered,

OAP hopes to achieve some measure of control over the emissions from cars on the road through its recall program planned for 1972 models. The recall program has one inherent weakness, however, in that the return of cars to the manufacturers for modifications when emissions exceed established standards is voluntary. The manufacturers are required to notify owners whose cars' emissions exceed standards, but the owners are not required to have the emission control systems modified.

As discussed on page 13, the Clean Air Amendments of 1970 required the automobile manufacturers to reduce the emissions of carbon monoxide and hydrocarbons from 1975 model cars by 90 percent from emissions allowable on 1970 models. Emissions of nitrogen oxides from 1976 model cars are to be 90 percent less than emissions measured on 1971 models.

The automobile manufacturers, threatened with the possibility of production shutdown in 1975 or 1976 if their cars do not meet the standards, are somewhat optimistic about meeting the hydrocarbon and carbon monoxide standards by 1975 but are pessimistic about meeting the nitrogen oxides standard by 1976. Some say it cannot be done with today's technology.

If OAP is to ensure that emissions are within established standards, not only when cars are produced but also after they are on the road, we believe that it is essential that OAP have an economical and effective nationwide program of prototype certification, assembly-line testing, and highway inspection. After a slow start progress is being made to develop such a program, but it probably will be a few years before a truly effective nationwide program can be implemented.

MATTER FOR CONSIDERATION BY THE CONGRESS

Generally in prior industry recall programs related to automobile safety, only 30 to 40 percent of the owners returned their cars for modicications. There is no reason to expect that a significantly greater number of owners would voluntarily return their cars for modifications when they are notified that their cars' emissions exceed the standards.

As a result the potential effectiveness of the recall program could be significantly lessened. The Congress may therefore wish to consider the need for additional legislation to require that automobile owners who have been notified that their cars' emissions exceed established standards return them for modification.

CHAPTER 4

RESEARCH, DEVELOPMENT, AND TESTING OF POLLUTION CONTROL SYSTEMS FOR CONVENTIONAL AUTOMOBILE ENGINES

Unlike the auto industry, OAP did not have the vast resources needed to undertake a comprehensive program to research and develop systems for controlling pollution from conventional automobile engines. Consequently the objectives of OAP's research and development (R&D) program were to "stimulate industry into continuing aggressive research toward development of new emission controls" and to "lead them [automobile manufacturers] into new work areas," i.e., areas of emission control not being explored.

An OAP official told us that the automobile manufacturers could not allow themselves to be put in the unfavorable position of falling behind others in technological developments. Therefore OAP hoped to stimulate the manufacturers not only to increase their efforts in ongoing R&D work but also to initiate R&D work in promising new areas identified as a result of OAP research. OAP's efforts, however, have met with limited success.

OAP's expenditures for emission control system work were dwarfed by industry expenditures. For example, OAP allocated $2.1 million for this activity during fiscal years 1969-71 and the three largest auto manufacturers reported spending about $157 million in 1970 alone.

In addition, OAP did not have a sufficient information collection and dissemination system so that all interested parties could be kept informed of OAP's and the automobile manufacturers' R&D efforts.

Detailed knowledge of the automobile manufacturers' R&D efforts is essential to proper planning of a program intended to stimulate the manufacturers and to lead them into new areas of emission control research. In view of OAP's limited funds, this need for information was even more acute to ensure that available resources were channeled into the

most potentially profitable areas. We found, however, that OAP had not sought aggressively to obtain this information.

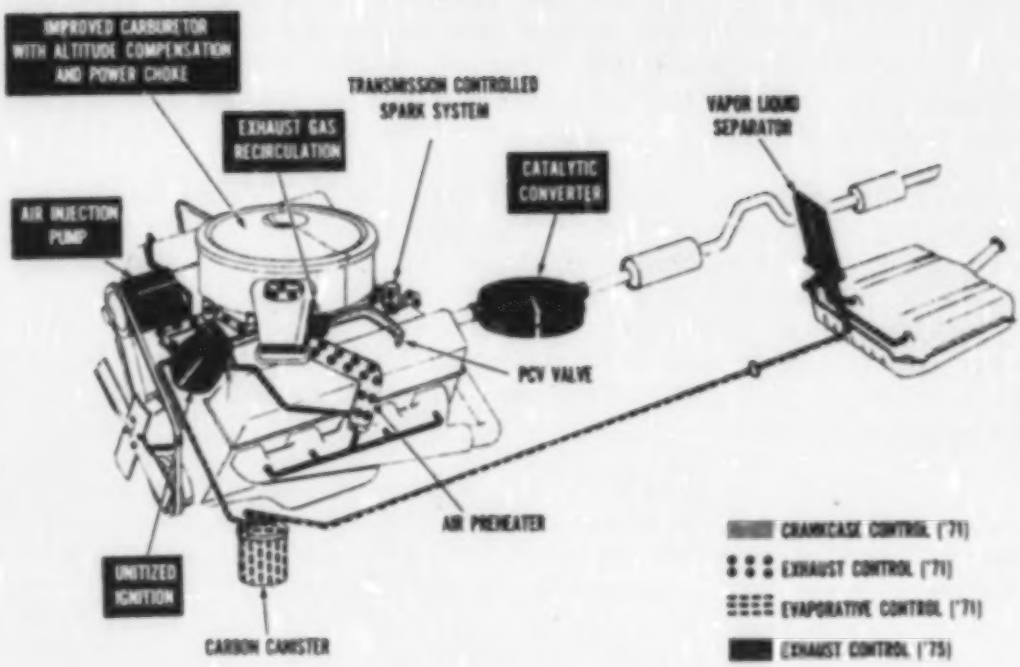
The auto industry's efforts to meet initial Federal emission standards for carbon monoxide and hydrocarbons, applicable to the 1968 through 1971 model years, were geared primarily to engine modifications and carburetor adjustments. As more stringent future standards for carbon monoxide and hydrocarbons were announced and as control of nitrogen oxides was proposed, efforts turned also to development of such "hang on" devices as catalytic converters and thermal reactors to further reduce emissions. The illustration on page 41 shows the emission control systems contemplated by one major automobile manufacturer for 1975 cars. This system of control is typical of the systems being considered by other manufacturers.

OAP officials told us that, before OAP initiated its R&D program in 1968, they verbally had requested detailed information from the automobile manufacturers on their programs for the development of emission control systems. The manufacturers did not always furnish the requested information, however, especially with regard to the amount of resources being devoted to various devices. OAP officials said that they had not put their requests in writing or had not requested written refusals from the automobile manufacturers, because they had no legislative authority to require that such data be provided. (Subpoena power subsequently was granted to EPA by the Congress in the 1970 amendments.)

Officials of the major automobile manufacturers told us that OAP's R&D efforts generally had produced results already well known throughout the industry and consequently of little or no benefit. For example, of the $2.1 million allocated by OAP during fiscal years 1969-71 for emission control system work, about $995,000 was spent studying engine and fuel modifications--modifications that automobile manufacturers generally began incorporating on new cars sold in California in 1966 and nationwide in 1968.

In addition, OAP spent about $720,000 of the $2.1 million on studies of catalytic converter and thermal reactor control devices. (A catalytic converter changes carbon monoxide and hydrocarbons into harmless water vapor and

1975 EMISSION CONTROL SYSTEM
Lead Free Fuel



carbon dioxide. A thermal reactor is an oversized exhaust manifold--a type of afterburner combustion chamber outside the engine.) One automobile manufacturer, at EPA's request, reported spending $3.3 million on similar devices in 1970. Also several other automobile manufacturers and several oil companies--involved in a cooperative program since 1967--reported spending $13 million to develop thermal reactors and catalytic converters and other control devices. OAP officials maintained, however, that OAP's efforts had stimulated some automobile manufacturers to publish results of some of their work that otherwise might have remained secret.

In February 1971, in accordance with authority granted in the 1970 amendments, OAP requested the automobile manufacturers to furnish it with cost information for their programs related to the development of emission control devices. The information submitted showed that the automobile manufacturers' expenditures dwarfed OAP's. For that reason and because the 1970 amendments placed on the automobile manufacturers the burden of cleaning up the conventional auto engine, OAP, late in 1970, discontinued its R&D of emission control devices for the conventional auto.

OAP did not have an effective system for disseminating information on the results of its R&D efforts. Some of the results of OAP's R&D were published in the form of technical papers in professional engineering publications, but OAP officials stated that these papers were not adequate substitutes for the more detailed reports. Auto industry officials told us that they often had to request reports on OAP's R&D efforts.

In addition to performing its in-house research, OAP tested and evaluated emission control devices developed by others. But reports on the results of these endeavors also frequently were not prepared or disseminated.

Prior to 1970, reports on the results of in-house tests, which dated back to 1955 and which covered a variety of control systems, were not prepared as a matter of practice. Since most devices tested were not effective, the results were not published. Information on the few devices that were effective was summarized in trade journals or technical papers presented to professional societies. Recognizing

that it was important to make known what did not work--as well as what did--OAP changed this practice so that, beginning in 1970, reports were prepared on all in-house work. Such reports, however, were given limited distribution, generally within the Federal Government.

In 1971 efforts were made to summarize and publish the results of in-house testing done prior to 1970 so that some benefit could be gained from the work. A consultant was hired to summarize the results of this previously unpublished work. He told us that there was no way of determining whether all significant test results had been included in his summary, which covered 16 projects, because of a lack of records.

The consultant recommended in June 1971 that a consistent reporting format be devised for future use and that all reports be distributed to interested parties in the engineering and enforcement fields. As of September 1971 OAP had not approved a standard distribution list. Tentatively reports were to be distributed to EPA regional offices, State and local air pollution agencies, and other interested parties. The automobile manufacturers were not on the proposed distribution list, although OAP officials told us that the manufacturers would be furnished with reports upon request.

Concerning the need for an information dissemination system, OAP has stated that:

> "*** dissemination of information is so important as to merit separate attention. Unless information is effectively disseminated, it is not capable of being used, and therefore useless -- and might as well not exist. Thus information dissemination must be specifically planned and programmed."

In recognition of this need, OAP began development of an information system in fiscal year 1971--summarizing information accumulated over the years, identifying potential users of the data, and devising a standard format for preparation and dissemination of the results of future work.

CONCLUSIONS

We believe that OAP's efforts to research, develop, and test control devices had little meaningful impact on the automobile manufacturers' R&D program to control emissions. OAP's efforts often appeared to parallel, if not to duplicate, those of the auto industry. OAP should have sought more aggressively to obtain, as a basis for planning and directing its own efforts, information on the direction and level of effort of the automobile manufacturers much sooner than it did. When subpoena power was granted and OAP obtained detailed information, the obvious disparity in financial resources added weight to the decision to discontinue further attempts to compete with the automobile manufacturers in the R&D of emission control devices.

Also OAP did not prepare and publish final reports on much of its R&D and test work. Although some technical papers containing synopses of project results were prepared and published in various journals, these papers were not adequate substitutes for the more detailed reports.

The success of OAP's R&D and testing program for control devices was limited, in our opinion, because OAP did not (1) have adequate financial resources, (2) obtain detailed information from the automobile manufacturers on a timely basis, and (3) disseminate all available information to interested persons.

CHAPTER 5

SEARCH FOR UNCONVENTIONAL LOW-POLLUTING AUTOMOBILE ENGINE

Recognizing the significance of the relationship of the automobile to the nationwide air pollution problem, the Congress, in the 1967 amendments to the Clean Air Act, authorized a greatly expanded program for research on reducing emissions from autos. Appropriations of $35 million and $90 million were authorized for fiscal years 1968 and 1969, respectively, for "research relating to fuels and vehicles." Subsequent authorizations for fiscal years 1970 and 1971 were $45 million and $75 million, respectively.

Because the auto industry seemed entrenched in its efforts to clean up the conventional engine to meet Federal standards, OAP in 1969 embarked on a program to develop an unconventional, low-polluting automobile engine. Late in 1969 an ad hoc panel was convened by the Executive Office of the President to evaluate industry's efforts to develop alternative power systems. The panel concluded that industry was not spending "enough on certain higher risk ideas." The panel also was concerned with the public view of what industry claimed it might or might not have done and with the credibility of these claims.

The panel's conclusion led to the President's announcement in February 1970 that the Federal Government, under the guidance of the Council on Environmental Quality, would seek to develop by 1975 a technically feasible, low-polluting engine as an alternative to the conventional engine. The purposes of developing an alternative engine were to provide a back up engine should industry fail to clean up the conventional engine to meet more stringent emission standards proposed, at that time, for 1980 and to stimulate industry to do similar work. It was believed that achievement of this goal would provide the automobile manufacturers with the 5 years they estimated were needed to put an alternative engine into mass production in time to meet the proposed 1980 standards.

In pursuit of this goal, OAP initiated two programs: the Advanced Automotive Power Systems Program--aimed at marshaling the expertise of private industry by contracting for R&D work on various types of unconventional engines--and the Procurement Incentive Program--aimed at stimulating private development and production of low-polluting engines by guaranteeing a market and premium prices to successful developers.

OAP's search for an inherently low-polluting engine has moved at a slow pace and, in our opinion, down too many trails. We found that:

--The commitment of resources, both money and manpower, to the search for a clean engine was not commensurate with the need, nor did it reflect the urgency of the need to resolve the air pollution problem.

--OAP's limited resources were spread over many engine systems--including those with little likelihood of timely success. This dilution of resources significantly slowed the pace of development of those engines offering more promise for early success.

--OAP did not obtain detailed information from the automobile manufacturers to (1) ensure that its limited resources were not spent duplicating work already performed by them on unconventional engines and (2) enable better direction of its efforts.

In addition, the fact that OAP was given responsibility for this complex program--which was later affected by changing goals and a shrinking time frame--during a period of organizational instability further slowed OAP's progress.

For fiscal years 1969-71 the Congress appropriated about $92 million, of which OAP spent about $10 million for R&D related to unconventional engines. The following sections discuss OAP's Advanced Automotive Power Systems and Procurement Incentive Programs.

ADVANCED AUTOMOTIVE POWER SYSTEMS PROGRAM

In a report issued on March 19, 1970, to the President's Office of Science and Technology, the ad hoc panel concluded that, in view of the probability that the internal-combustion engine would not be clean enough to meet long-term air-quality requirements, it was urgent that Federal action be intensified to develop an alternative power system as soon as possible. Acceleration of this program was considered essential because the development of automotive power systems to the production stage was a long process.

The panel ranked the most promising engines in the following order.

1. Gas turbine.
2. Hybrid engine (battery combination or flywheel).
3. Rankine cycle engine (steam engine).
4. All-electric engine.

Specifically the ad hoc panel recommended the following Federal actions for each alternative.

--Gas turbines--Fund the investigation of novel ideas for critical components not otherwise being pursued.

--Hybrid engine--Solicit and fund investigation of a number of different hybrid power plant systems.

--Rankine cycle engine--Encourage development of components rather than of a total system.

--Electric engine--Limit funding of innovative electrochemical systems.

To meet its responsibilities in this area, the Council on Environmental Quality established the Advisory Committee on Advanced Automotive Power Systems. The Committee, which consists of representatives from the auto industry, the academic and scientific community, and the Federal Government, has met quarterly since July 1970.

Although many of the conclusions of this Committee were similar to those of the ad hoc panel, differing emphasis was

given to the various alternatives. For example, the ad hoc panel in its March 1970 report recommended that potentially viable engines be moved into development and that others be "laid to rest." The Committee, on the other hand, recommended in July 1971 that research be continued on all engines.

The ad hoc panel considered the gas turbine as the most promising engine because the automotive and aircraft industries had gained considerable experience with gas-turbine technology, the major problem areas had been identified, one automobile manufacturer had accumulated more than a million test miles on cars with gas turbines, and two firms were readying plants to mass-produce turbines for trucks. Thus the ad hoc panel recommended an expanded program for development of the gas turbine.

The Committee concluded that Federal participation in the development of a gas turbine should start when private industry submitted an engine to OAP for test and evaluation, which the industry estimated could be done early in 1972. At the same time the Committee placed considerably more emphasis on development of electric cars than did the ad hoc panel.

Until July 1971 the OAP program generally was in accord with the Committee's conclusion that OAP should spread its limited resources among the several alternatives. Although the Committee indicated that it was impressed with the quality of work being done on the Rankine cycle engine, little progress was made on any engine, and invaluable time slipped by. Although the gas turbine was considered by OAP and industry to be the most promising engine, OAP spent only $354,000 on its development through April 1971. In May 1971 OAP awarded four contracts totaling about $694,000 for studies related to nitrogen oxides and optimum configuration of the gas turbine. In contrast, OAP spent $880,000 through April 1971 on development of the all-electric engine.

In July 1971 EPA decided to discontinue work on the all-electric engine and to defer, for several years, work on hybrid engines so that all available resources could be allocated to the three engines considered by EPA as having the greatest potential for early success. Although EPA realized

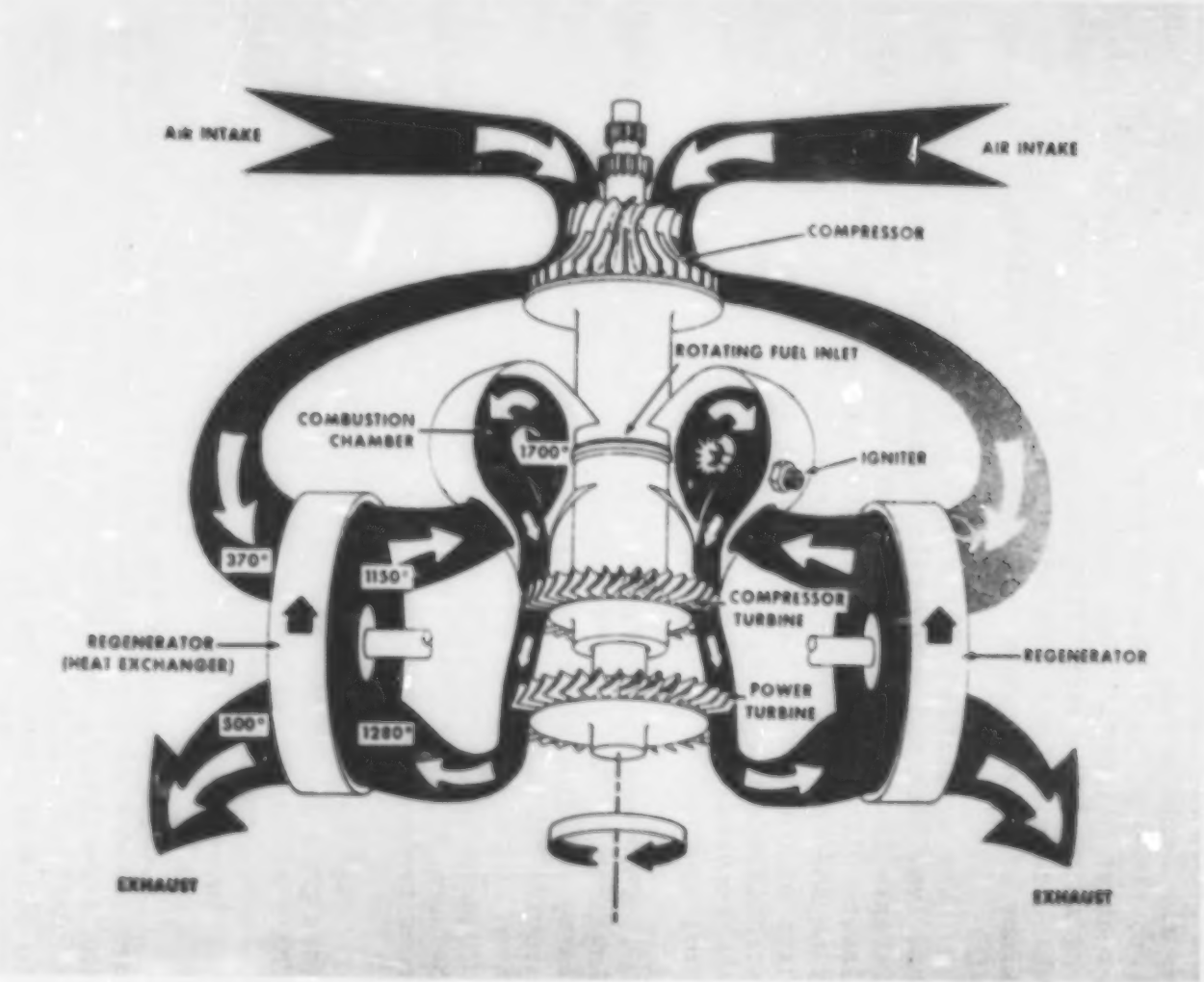
the need for concentrating its resources, a major influence on the decision was a reduction in the fiscal year 1972 budget. (See p. 53.) The engines considered to have the greatest potential were the gas turbine, the Rankine cycle engine, and the stratified-charge internal-combustion engine which recently had been added to the program. (Illustrations of these engines are shown on the following pages.)

The stratified-charge engine was under development by the Army Tank and Automotive Command of the Department of Defense in conjunction with the Ford Motor Company and the Texaco Oil Company. This engine differs from the gas turbine and the Rankine cycle engine in that it is a modification of the conventional internal-combustion engine. The stratified-charge engine provides fuel economy comparable to the conventional engine, but it also requires emission control devices.

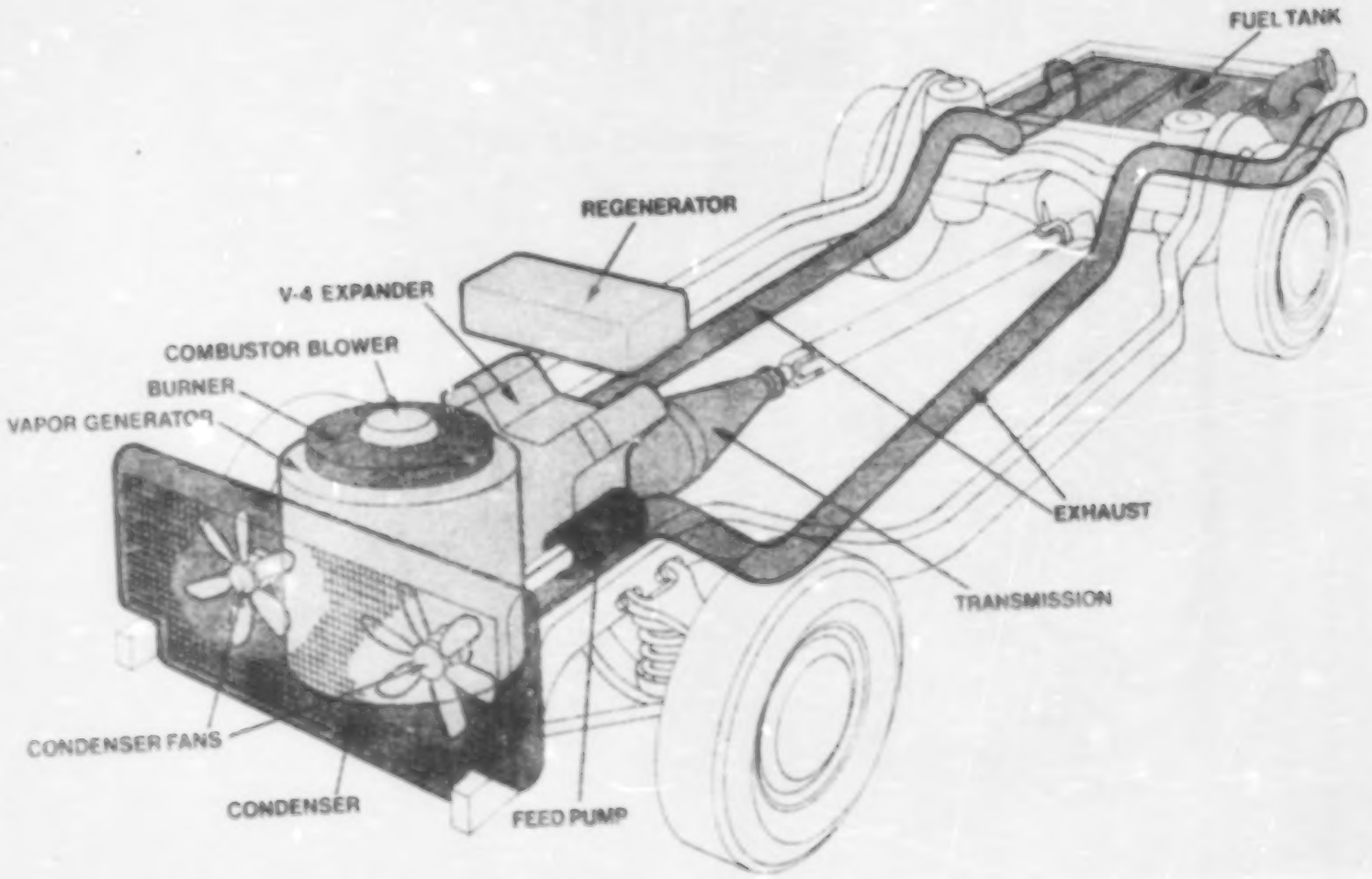
This engine originally was designed for use on a jeep. Research by OAP indicated that control of emissions from these vehicles was promising. EPA concluded that it should provide the command with financial assistance for the pollution control aspects of this engine, because the prospects appeared good that it could meet EPA emission standards and because it would require a less dramatic departure from current technology than would the other engines.

OAP tests in September 1971 indicated that emissions from this engine met the 1975 and 1976 emission standards. The vehicle tested had accumulated only limited mileage, however, and at that time had not demonstrated that it could continue to meet the standards for the required 50,000 miles.

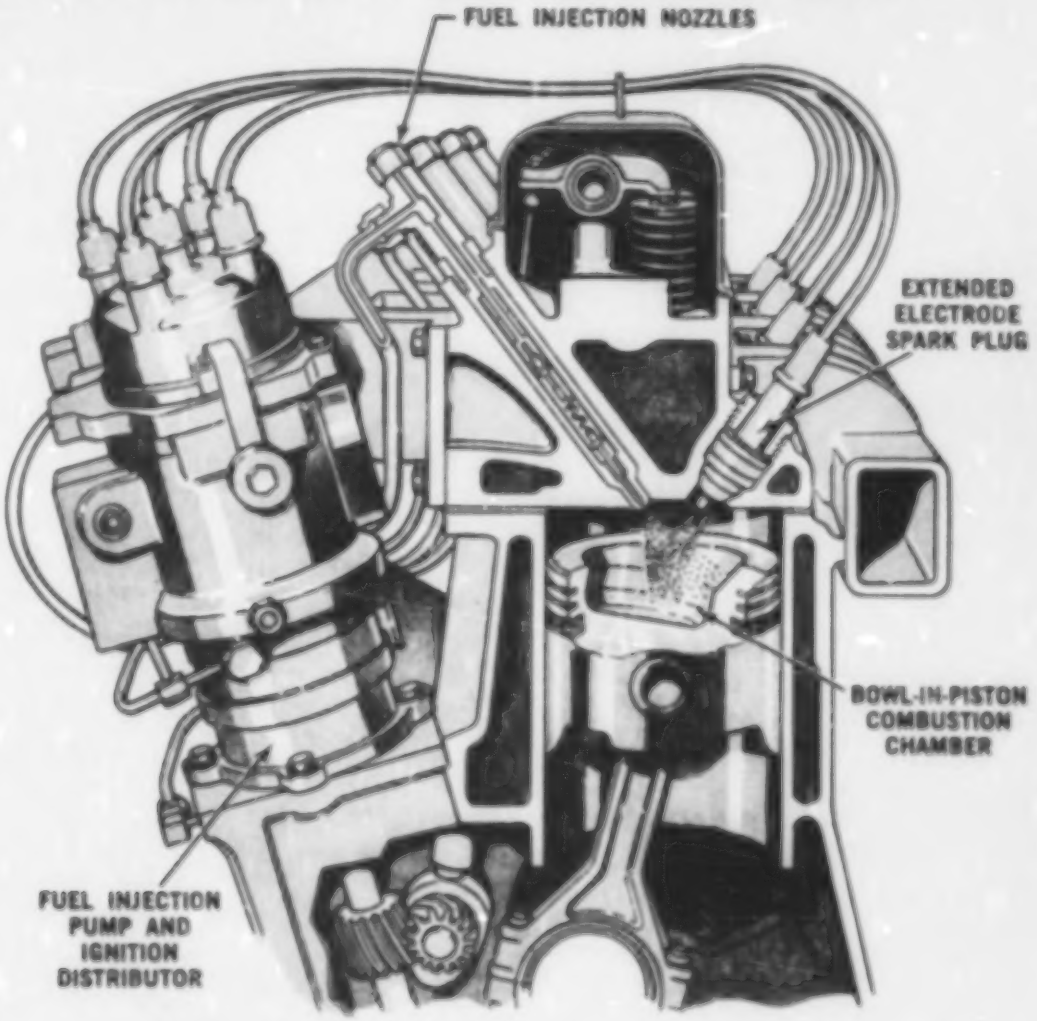
A major factor to the July 1971 decision to discontinue development of some engines and to concentrate on three was the reduction by the Office of Management and Budget (OMB) of OAP's fiscal year 1972 budget request from $19.5 million to $10.8 million. The following table shows the proposed allocations to the engine development programs both before and after the reduction in the 1972 budget.


AIR INTAKE
AIR INTAKE
COMPRESSOR
ROTATING FUEL INLET
COMBUSTION CHAMBER
1700°
IGNITER
370°
1150°
COMPRESSOR TURBINE
REGENERATOR (HEAT EXCHANGER)
REGENERATOR
POWER TURBINE
500°
1280°
EXHAUST
EXHAUST

RANKINE CYCLE VAPOR ENGINE



STRATIFIED CHARGE INTERNAL COMBUSTION ENGINE


FUEL INJECTION NOZZLES
EXTENDED ELECTRODE SPARK PLUG
BOWL-IN-PISTON COMBUSTION CHAMBER
FUEL INJECTION PUMP AND IGNITION DISTRIBUTOR

	Allocation under OAP request	Allocation under OMB approval	Increase or decrease(-)
	(millions)		
Gas turbine	$ 4.9	$ 3.6	-$1.3
Rankine cycle engine	2.5	5.2	2.7
Stratified-charge engine	2.0	2.0	-
Total	9.4	10.8	1.4
Hybrid electric-heat engine	5.5	-	-
Hybrid flywheel-heat engine	1.0	-	-
All-electric engine	1.5	-	-
Diesel engine	1.7	-	-
New concepts	.4	-	-
Total	$19.5	$10.8	$1.4

As shown above, a significant amount of the requested funds was planned for development of hybrid engines. In June 1971, less than a month before the decision to defer development of hybrid engines, OAP awarded five contracts amounting to $648,000 for research on two types of hybrid engines. OAP officials told us that, at the time the contracts were awarded, they were unaware that development of these systems was to be deferred.

The shortage of trained technical employees and the limited funds available and the allocation of those funds to the development of several engines contributed to the limited progress made in the Advanced Automotive Power Systems Program. According to the Advisory Committee on Advanced Automotive Power Systems, in December 1970 the program had an acute shortage of trained employees and lacked a sufficient number of experienced, highly skilled specialists. The Committee stated that the staff was a minimal one, and it emphasized that adequate manpower was critical during the early stages of a program when objectives were being formulated.

At the end of fiscal year 1971, the Advanced Automotive Power Systems Program staff totaled 15--nine more than the previous year. OAP still considered this number insufficient, and OAP was negotiating with a private firm to provide needed engineering services.

OAP's relationship with auto industry

As it had in its program for development of emission control devices for the conventional engine, OAP sought to stimulate the automobile manufacturers to increase their efforts on the development of unconventional power systems. An obvious question is: Did OAP--considering its time and money constraints--take full advantage of the automobile manufacturers' experience and knowledge gained from years of research? We think not!

The auto industry has been working for many years on the development of alternative power systems, spending about $36 million in 1970 alone. It annually spent more on one engine, the gas turbine, than OAP annually spent on all engines in its program. Over the years various automobile manufacturers have built and tested experimental vehicles powered by unconventional engines. One company put 50 gas-turbine-powered autos in the hands of the public for experimentation and accumulation of test miles.

Auto industry officials told us that they had done research on the engines in OAP's program and had progressed to the point where technological breakthroughs were needed. They expressed the belief that OAP was duplicating much of their effort and stated that information on their effort was available for OAP's review and evaluation. These officials stated also that OAP had maintained an "arms length relationship" with them, apparently to avoid criticism of OAP's relying too heavily on what industry had done.

OAP's knowledge of the auto industry's efforts in developing alternative power systems has been limited generally to information obtained orally in meetings. An OAP official told us that OAP was not aggressive in seeking information that industry officials seemed reluctant to divulge. He said that detailed information on the industry's areas of concentration and the results of its R&D work had not been

pursued. Other OAP officials told us, however, that their contacts with industry officials provided them with sufficient information so that they were aware of the status of development of the various alternative power systems.

In February 1971 EPA requested foreign and domestic automobile manufacturers to furnish it with certain information related to the basic techniques being explored as a means of meeting the 1975 and 1976 emission standards. The manufacturers furnished EPA with a considerable amount of detailed information in response to that request. As a result significant information became available to OAP for its consideration in directing its program.

We believe that OAP should have developed a better working relationship with the auto industry and should have obtained needed information to better plan and direct its Advanced Automotive Power Systems Program. Such information could have provided needed assurance that OAP's efforts did not duplicate work previously undertaken by the industry.

PROCUREMENT INCENTIVE PROGRAM

The objective of the Procurement Incentive Program is to provide

> "*** a mechanism and an incentive for ensuring that viable approaches existing anywhere in the world for meeting the required emission standards and which are not being pursued either by the automobile industry or by the federal government are given the opportunity to demonstrate their potential."

The program offers incentives to suppliers of low-emission vehicles under two purchasing methods.

--Developmental vehicles will be purchased for test and evaluation under the Federal Clean Car Incentive Program.

--Operational vehicles will be purchased for Government fleet use under the Low Emission Vehicle Procurement Program.

Federal Clean Car Incentive Program

Through its Federal Clean Car Incentive Program, OAP hopes to stimulate privately funded development and limited production of low-polluting cars by 1975. The program began in 1969 and is being carried out in three phases--prototype, demonstration, and fleet vehicles. In the first phase a developer leases one prototype vehicle to OAP for testing and evaluation. If OAP concludes, on the basis of its tests, that the vehicle merits further consideration, OAP contracts with the developer to buy 10 prototypes to be used in demonstration tests. For those vehicles that OAP still considers promising after the demonstration tests, it will contract with the developer to purchase up to 500 vehicles for fleet testing.

Vehicle performance requirements become increasingly stringent as the program progresses through the three phases. At each step in the process, those engines which appear to have the least potential for completing the program will be

weeded out. The lease fees and purchase prices are to be negotiated at each phase.

In October 1970 OAP solicited proposals from more than 200 firms. As of September 1971, about 20 firms had submitted proposals and seven firms had been awarded contracts for the first phase. The contracts were awarded on the basis of evaluations made by a consulting firm and by OAP. Leasing fees for the seven contracts totaled $225,000. The consulting firm recommended that four of the seven firms not be awarded contracts for a variety of reasons, including questionable aspects of proposed engines and weaknesses in, or lack of, technical capability, financial resources, and facilities. An OAP official told us that the four contracts had been awarded, however, because OAP's conclusions, in evaluating the proposals, were not always the same as the consulting firm's; because some firms complained to their congressmen; and because only a small amount of Government funds was being risked.

Four of the seven contracts awarded under phase I pertained to development of add-on devices or modifications to internal-combustion engines. One contract each was awarded for the development of vehicles with diesel engines, Rankine cycle engines, and hybrid (heat and battery) engines.

Three firms, whose proposals were considered most likely to result in viable engines (two gas turbines and one Rankine cycle engine), implied a need for Government financial assistance to complete all phases of the program. OAP officials told us that the three firms had not been awarded contracts under phase I because OAP would not agree in advance to the firms' requests for specific purchase prices for 10 vehicles under phase II--prices that would include reimbursement for some of the R&D costs. One firm, for example, indicated a need for $500,000 for each of the 10 vehicles.

The major domestic automobile manufacturers did not submit any proposals under this program. One manufacturer's representative told us that there was no incentive for his company to participate because it would spend far more than the Government would reimburse to produce the small quantities of cars called for in the three phases. Several other private developers told us that the program provided them with no incentive.

A major foreign automobile manufacturer expressed interest in the program to OAP but declined to submit a proposal and stated that the 1970 amendments forced its company to concentrate its efforts on the conventional engine.

Thus we found a general feeling that the program did not offer the incentives considered necessary to attract proposals from many of the firms and individuals toward whom the program was directed. Also, because of the Government's policy of normally retaining rights to inventions resulting from work financed by the Government, OAP did not offer potential applicants the incentive of receiving any patent rights attributable to their work. We were informed that EPA's Office of General Counsel was working with OAP to find a solution to the patent problem that was not inconsistent with the Federal Government contracting practices.

Low Emission Vehicle Procurement Program

Section 212 of the Clean Air Amendments of 1970 authorized the General Services Administration to purchase, for use in Government fleets, vehicles that have been certified by the Vehicle Certification Board as being low-emission vehicles. The purchase price can be as much as 150 percent of "the retail price of the least expensive class or model of motor vehicle for which they are certified substitutes." The amendments also authorized the establishment of a Low Emission Vehicle Certification Board to certify low-emission vehicles. The board consists of officials from EPA, the General Services Administration, and the Department of Transportation and other members appointed by the President.

The amendments also required EPA to prescribe regulations relating to the factors to be considered in certifying low-emission vehicles. EPA published regulations on October 9, 1971, that were applicable to 1973 and 1974 model year cars.

No applications had been submitted to the Board as of November 1971. One automobile manufacturer told us that the program provided no incentive for the manufacturer to participate because the purchase-price premium would not offset the cost of producing a limited number of cars.

CONCLUSIONS

The commitment of resources to the search for a low-polluting alternative to the internal-combustion engine has been considerably less than that considered necessary to accomplish the program objectives by 1976. In addition, OAP's allocation of the limited resources over many engines, including those with little likelihood of timely success, slowed the R&D work related to the more promising engines.

OAP did not have adequate knowledge of the auto industry's efforts in developing low-polluting unconventional engines. Without that knowledge OAP was not able to plan its program to take full advantage of the industry's successes and failures. Consequently OAP lacked assurance that it was not duplicating work done by the industry. OAP, in our opinion, should develop a better working relationship with the auto industry to take advantage of the industry's efforts. Auto industry officials have expressed a willingness for a closer working relationship.

Our review of the Procurement Incentive Program indicated that the incentives, to date, had not been sufficient. Some individuals told us that the cost of producing the limited number of cars required in the program would far outweigh the Federal purchase prices of the cars. In addition, these individuals indicated that the Government's patent policy acted as a disincentive. Thus it appears to us that, if the program is to be successful, additional incentives to private developers are needed.

CHAPTER 6

SCOPE OF REVIEW

The objective of our review was to identify the progress made and the problems encountered in controlling auto-caused air pollution. We reviewed the applicable legislative history and OAP's regulations, policies, procedures, and practices for motor vehicle control programs. We also examined OAP records and files pertaining to both in-house and contract efforts to control emissions from motor vehicles.

We did not review OAP's efforts to control stationary sources of air pollution, such as factories and power-generating plants, nor did we review the standard-setting process or evaluate the validity of standards that had been established.

Our review was made primarily at OAP's motor vehicle facilities located in Ann Arbor and Ypsilanti, Michigan. We also interviewed officials and obtained information at EPA headquarters in Washington, D.C.; OAP headquarters in Rockville, Maryland; the OAP technical center in Durham, North Carolina; and OAP's test laboratory in Los Angeles, California.

In addition, we interviewed representatives of State and private organizations, including the California Air Resources Board, three major auto manufacturers, two major oil companies, and several small manufacturing firms. We interviewed also several inventors of advanced automotive engines.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

3 MAR 1972

Mr. Edward A. Densmore, Jr.
Assistant Director, Civil Division
General Accounting Office
Room 1689, Parklawn Building
5600 Fishers Lane
Rockville, Maryland 20852

Dear Mr. Densmore:

We have reviewed your Draft Report to Congress "Cleaner Engines for Cleaner Air: Progress and Problems in Reducing Air Pollution from Automobiles." The report is generally quite fair and accurate. It documents the difficulties encountered in developing and implementing a technically complicated program and the progress that has been made since 1970.

In the discussion of in-use vehicles inspection programs, I think note should be taken of the fact that the Office of Air Programs (OAP) has been and is today working hard to overcome the technological obstacles involved. The lack of progress comes from an unwillingness on OAP's part to install programs for which there is no practical method to judge effectiveness.

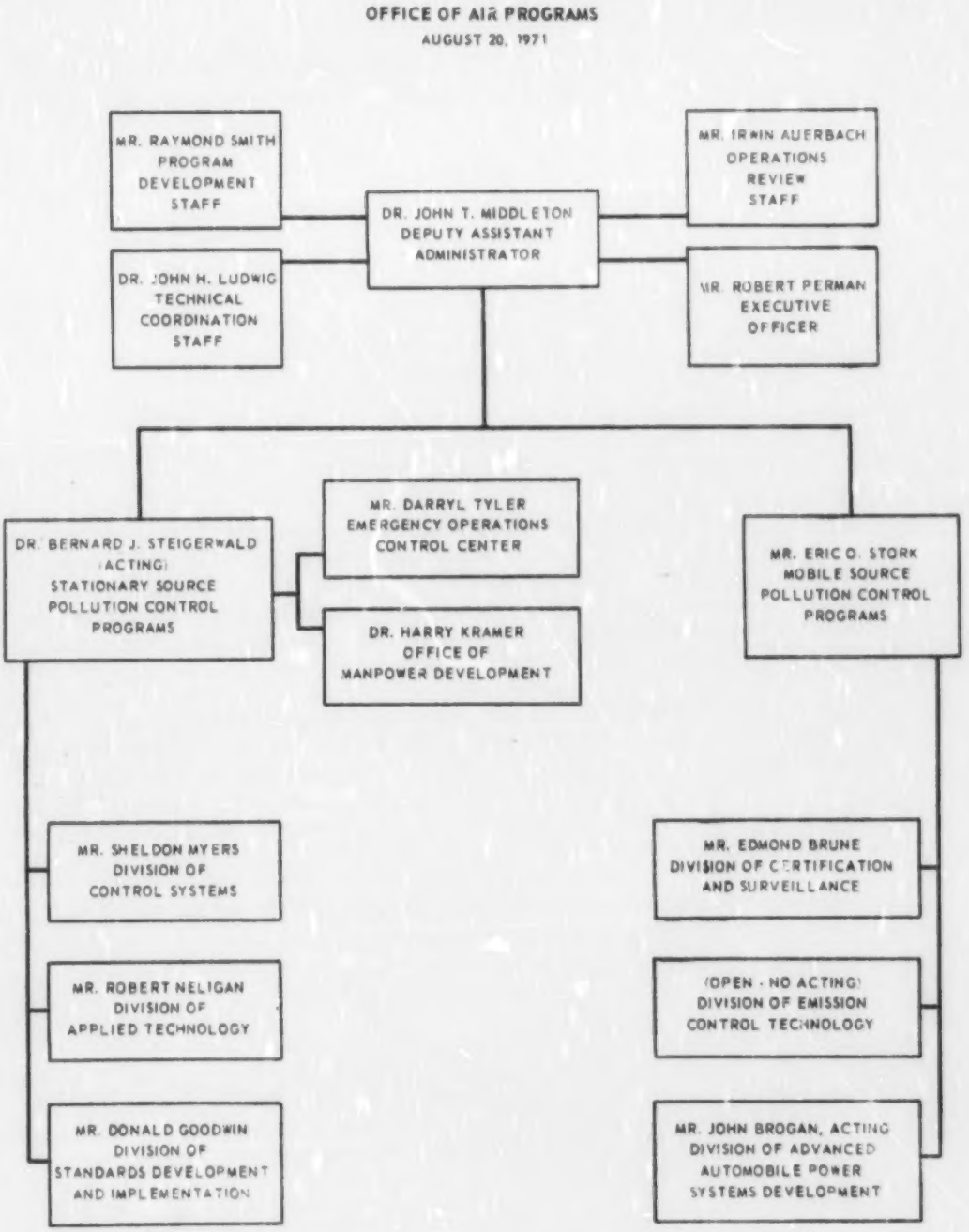
A list of specific comments is enclosed. We appreciated the opportunity to review your draft report.

Sincerely yours,

Thomas E. Carroll
Assistant Administrator for
Planning and Management

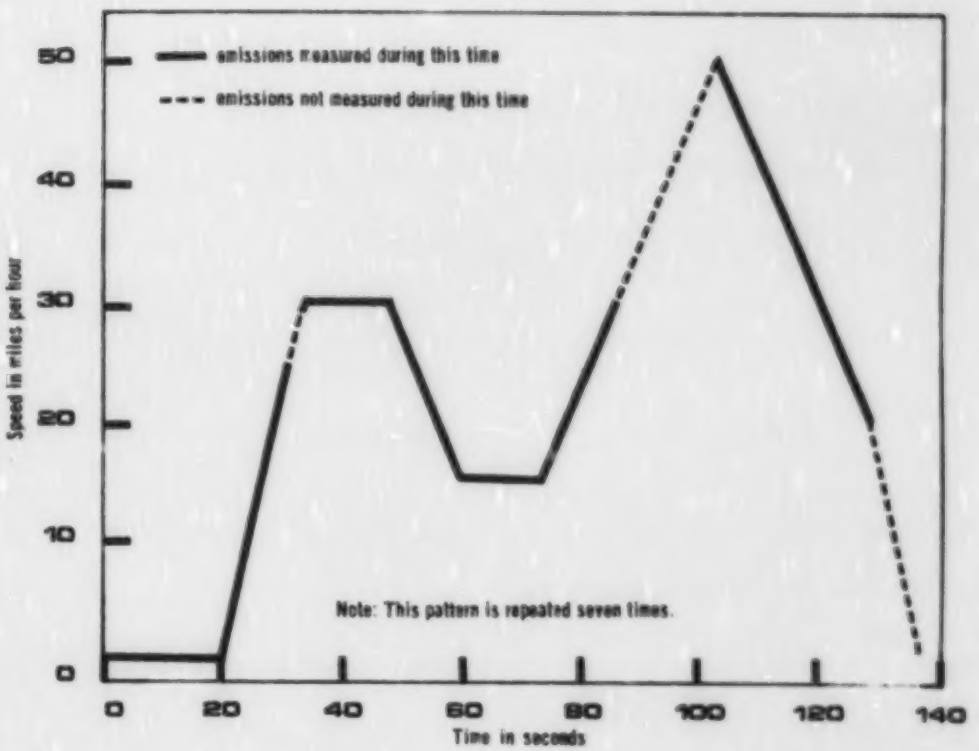
Enclosure

APPENDIX II


OFFICE OF AIR PROGRAMS
AUGUST 20, 1971
MR. RAYMOND SMITH
PROGRAM
DEVELOPMENT
STAFF
DR. JOHN H. LUDWIG
TECHNICAL
COORDINATION
STAFF
DR. JOHN T. MIDDLETON
DEPUTY ASSISTANT
ADMINISTRATOR
MR. IRWIN AUERBACH
OPERATIONS
REVIEW
STAFF
MR. ROBERT PERMAN
EXECUTIVE
OFFICER
DR. BERNARD J. STEIGERWALD
(ACTING)
STATIONARY SOURCE
POLLUTION CONTROL
PROGRAMS
MR. DARRYL TYLER
EMERGENCY OPERATIONS
CONTROL CENTER
DR. HARRY KRAMER
OFFICE OF
MANPOWER DEVELOPMENT
MR. ERIC O. STORK
MOBILE SOURCE
POLLUTION CONTROL
PROGRAMS
MR. SHELDON MYERS
DIVISION OF
CONTROL SYSTEMS
MR. ROBERT NELIGAN
DIVISION OF
APPLIED TECHNOLOGY
MR. DONALD GOODWIN
DIVISION OF
STANDARDS DEVELOPMENT
AND IMPLEMENTATION
MR. EDMOND BRUNE
DIVISION OF CERTIFICATION
AND SURVEILLANCE
(OPEN - NO ACTING)
DIVISION OF EMISSION
CONTROL TECHNOLOGY
MR. JOHN BROGAN, ACTING
DIVISION OF ADVANCED
AUTOMOBILE POWER
SYSTEMS DEVELOPMENT

APPENDIX III

DRIVING CYCLE FOLLOWED IN
SEVEN-MODE SEVEN-CYCLE TEST



APPENDIX IV

PRINCIPAL OFFICIALS OF THE ENVIRONMENTAL PROTECTION AGENCY AND THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE RESPONSIBLE FOR ADMINISTRATION OF THE MOTOR VEHICLE POLLUTION CONTROL PROGRAM DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
ENVIRONMENTAL PROTECTION AGENCY (note a)		
ADMINISTRATOR:		
William D. Ruckelshaus	Dec. 1970	Present
ASSISTANT ADMINISTRATOR FOR AIR AND WATER PROGRAMS:		
Donald Mosiman	Feb. 1971	Present
DEPUTY ASSISTANT ADMINISTRATOR FOR AIR PROGRAMS:		
Dr. John T. Middleton (note b)	Dec. 1970	Present
DIRECTOR OF MOBILE SOURCE POLLUTION CONTROL PROGRAMS:		
Eric O. Stork (note c)	Oct. 1971	Present
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE		
SECRETARY OF HEALTH, EDUCATION, AND WELFARE:		
Elliot L. Richardson	June 1970	Present
Robert H. Finch	Jan. 1969	June 1970
Wilbur J. Cohen	Mar. 1968	Jan. 1969
John W. Gardner	Aug. 1965	Mar. 1968

[a]Became effective on December 2, 1970, in accordance with Reorganization Plan No. 3 of 1970.

[b]Commissioner of the National Air Pollution Control Administration from January 1967 when it was in HEW.

[c]Designated as a special assistant for mobile source pollution control in HEW in July 1970.